THE ARTICULATION OF SCHOOL AND COLLEGE WORK IN THE SCIENCES [1]

I

THE question adumbrated by the title is one which has been settled, in its main outlines, for the languages and mathematics.

In the languages, knowledge of grammar, capacity to read certain authors, which are much the same throughout the country, and power to translate from English into each language, are provided by the schools in packets labeled one, two, three, or four years, according to the time spent on each study by each pupil. The college announces courses in similar sequence as regards difficulty, and leading up to authors not named by school program. These courses supply sequels to each of the the units of school work. The instructor in the college knows the content of the school courses, and proceeds to exact a reasonable advance beyond this for every major of college work.

In mathematics, the titles trigonometry, advanced algebra, and analytics are the names borne by the college courses, and at least two of these obviously stand for lines of mathematical work which are new to the entrant, who presents an equipment in elementary algebra and plane and solid geometry only.

Standards may, and doubtless do, differ considerably even where the subjects are so well defined as these have come to be. "Virgil" does not mean the same thing identically in every school; "trigonometry" does not mean the same thing identically in every college, but each college fits its standard to that of its feeding schools. The college gives full recognition to the work of the school, while the school assumes the responsibility of preparing for the classes of the college.

The basis of such correlation as exists lies, therefore, in the fact that the school work is definite and uniform, and that the college work in the same branches of study has the same

[1] Expanded from a report presented to the N. E. A. in July 1898 (Report for 1898, p. 964), and a paper read before a joint meeting of the high school and college sections of the Illinois Teachers' Association in December 1898.

characteristics. The result is that definite admission credit is given by all colleges for work in linguistic and mathematical lines, and that definite advancement to a corresponding extent is granted on the strength of this in every college. The examination of the case of science will show that a distinction must be drawn between *credit* and *advancement*. They go together, by common consent, in the case of languages and mathematics only.

The fit may not yet be ideal, but an equitable adjustment has been found possible. The theory is that every bit of school work must count for something towards the ultimate bachelor's degree, and that, in the transition from school to college, as little loss of time and power as possible must be encountered. The school and the college have worked separately and together towards the achievement of this correlation. The college has, doubtless, exercised a subordinate influence, as it should, on the evolution of the school course. But it has assisted in setting the pace and in marking out the path which has finally been adopted as the best for the pupil, whether he goes to college afterwards or not.

SCHOOL SCIENCE *in esse*

This happy state of affairs has not even been approached so far as the sciences are concerned.

In the schools we have physics from the text-book in the first year, and physics with laboratory work, after mathematics, in the third and fourth years. We have botany, zoölogy, chemistry, geology, and astronomy with similarly great variability. Sometimes no science is required in the school at all. Even if there are laboratories the work may still present divergences in effectiveness. In botany, for example, all the time may be given to the systematic side and the collection of herbaria, or it may be largely occupied by technique and minute histology, and so escape conveying any conception of the science at all. There are few schools in the country where ecology and vegetable physiology occupy the important place which they deserve. In chemistry the laboratory may partake more or less of the nature of a place for study by the laboratory method. In such cases we have first-hand contact with the subject-matter of the science

itself and acquisition of real knowledge, rather than the acquaintanceship with the shadow of it in a book. But, on the other hand, the pupil may know beforehand the result of every experiment and find in the work only relaxation for the brain and agreeable exercise for the muscles. In other schools he may receive a little instruction in the properties of a few substances in the class room and, for laboratory work, be set to do nothing but qualitative analysis. This will be done in an entirely unintelligent and mechanical way, as far as the chemistry involved goes, while the boasted exercise in reasoning and its systematic application, which the inductive study of the plan of analysis involves, can be obtained in more concentrated form in whist. But the course will be inexpensive for the school and for the teacher very easy to organize and conduct.

Other teachers may give instruction in two different languages at most; but to the teacher of the sciences are assigned as many periods per day as to the rest and he must cover four or five subjects. He must struggle as valiantly as may be with the provision and preparation of material for the work and with the myriad details connected with organizing and carrying on efficient laboratory courses. He is expected to do work sufficient in amount to occupy the time of two other people and still maintain a quality equal to that in better manned departments. When we add that his preparation to teach has usually been less thorough than that of the teachers of languages, that he has often had but one year's instruction in each subject while four to six years are considered necessary for preparation in teaching a language, it will be seen that uniformity or system are the last things we should look for in the scientific acquisitions of the high-school graduate. We should expect a group of pupils from a number of different schools, such as might come together to form a college class in a given science, to be most marvelously heterogeneous in their preparation to continue the study of that science. It may safely be said that, in the experience of every college instructor, this expectation is usually fulfilled to the letter.

Most of the above statements are not made in a critical spirit, and none of them are criticisms of high school as distinct

from college work. They are merely an enumeration of some indisputable facts. The courses, even when they represent extreme departures from the normal, are often well taught and good in themselves. The circumstances of a school often make the adoption of some marked departure from the normal (such as the teaching of botany without laboratory work, or by an ill prepared teacher) seem the best way under these special circumstances. I merely raise the question whether, in the broadest point of view, so much diversity is consistent with the best results all round: whether, to be more specific, the correlation which has been reached for mathematics and languages would ever have been possible if the same irregularities had characterized their treatment by different schools.

SCIENCE IN THE COLLEGE *in esse*

When we study the state of science teaching in the college, with a possible correlation with school work in mind, we find that a similar diversity prevails. There are colleges to which an appreciation of the value of the laboratory as an instrument in teaching does not seem yet to have penetrated. The abnormalities of school science are often brought with the teacher from the college in which he studied, and these are therefore a consequence and, *ipso facto*, an evidence of the existence of the same state of affairs in colleges as a whole. One is often tempted to think that, in colleges, the teaching of each science approaches one or other of certain extreme types, rather than any type which might be selected as normal. To hope for easy correlation of the work of any school with that of several colleges, or of the courses of several schools with that of one college, is therefore vain under the present circumstances.

THE RECEPTION OF SCHOOL SCIENCE BY COLLEGES *in esse*

If we turn now to the reception this heterogeneous school material receives from the college, we find that, when it is recognized at all, the greeting is anything but cordial. I have studied the subject in detail only so far as relates to chemistry. It is probable, however, that the conclusions to which this leads

would fairly represent the facts for the other sciences as well.

An examination of the catalogues of the fifty-six leading colleges and universities of the country, supplemented by correspondence, where necessary, seems to show that their treatment of school chemistry throws them into four classes. The list of institutions was that employed by the committee of the National Educational Association on college entrance requirements, and may be regarded as representative.

It is found at the outset that nearly half (twenty-six) do not require or accept chemistry in preparation for any college course whatever. These form the first class.

Of the remaining thirty, all but three are almost equally divided between the next two classes.

The second class includes those institutions which accept chemistry, of almost any kind, apparently, as an entrance subject, and treat chemistry entrants exactly like other students, placing them in the same class in general chemistry with beginners and granting no advancement in any form.

It is very evident that the first two classes are doing all in their power to discourage the teaching of chemistry in schools, and, indeed, it is only too probable that their officers are among those who express the wish that their pupils had never encountered the subject in school at all. Yet their own actions foster the very evils which they deplore, and they must shoulder a large part of the blame for the want of uniformity in school chemistry. If, after three weeks, they cannot distinguish between those of their students who have had previous instruction in chemistry and those who have not—and this very statement has been made to me by a prominent professor—it is very evident that it was they who failed to draw a sufficiently sharp distinction between chemistry and no chemistry, as an admission credit, when the students entered college three weeks before. If a definite amount of, and standard in school chemistry, were insisted on for entrance, it is not conceivable that the knowledge this represented should be entirely dissipated by three weeks of any kind of further instruction. At least this marvel is not observed in the case of geometry or German.

The colleges of the third class are controlled in their attitude towards the schools by the nature of their own courses in chemistry. They give their own beginners a very slight preparation in general chemistry, and devote most of their energy to teaching analysis. Many school courses are therefore good enough to take the place of their own introductory work, and the chemistry entrants are roughly sifted, and some are advanced at once into qualitative analysis. This misconception as to the whereabouts of the center of gravity of the science was formerly much more common than it now is. It arose partly from the idea that chemistry was a practical subject, and that therefore the practically useful part of the science was the one to attack first. The old plan, however, of teaching formal analysis to students lacking sufficient preparation to understand it is happily dying out. This form of quasi-encouragement, therefore, arising from the low standard of the college itself, is likely soon to vanish. The harm it has worked to the science as a whole has been far more conspicuous than any fitful help it has given to the school.

In this connection it is worth noticing that some of the institutions which thus admit the equivalence of their college chemistry to that of many schools, do not make the same admission in regard to physics. Entrants in physics are required to take the college course in the same subject. Either the college physics is higher in standard than the college chemistry or school physics is very generally inferior to school chemistry. Anyone who knows school work will unhesitatingly reject the latter alternative.

The fourth and last class is characterized by the maintenance of thorough college courses in general chemistry while they specify a definite entrance unit in the subject and have a definite system for placing those who have thus effected a partial anticipation of the college course. There are but three institutions in this group, and each pursues a different plan in the effort to give effect to these principles.

The above facts show that the college, if its treatment of chemistry is accepted as typical, is as undecided about what it shall do with science accepted for admission as the school is

about the kind and amount of each subject it shall proffer. The college and the school must share the blame for the irregular recognition which the efforts of the latter receive. While it is maintained that the interests of the majority of its pupils forbid the school to accept dictation from the college in regard to the nature of its courses, it is nevertheless true that the influence of the college has been legitimately helpful to school work in languages and mathematics. It is unfortunately equally true that the college has been perfectly helpless, if not discouraging, in its influence on school work in science.[1]

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(To be continued.)

[1] The Harvard physics requirement constitutes a notable exception to this statement, but its influence has touched a small minority only of the schools of this country.